CLAIM LISTING

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (currently amended): A method of determining measures of cardiac function in a patient including the steps of;

(i) generating an alternating current signal at multiple simultaneous frequencies from a constant current source electrically isolated from the patient;

(ii) applying the current to an outer pair of electrodes on the patient;

(iii) measuring a voltage signal across an inner pair of electrodes on the patient;

(iv) demodulating the current signal and voltage signal to extract signals at each of said multiple frequencies;

(v) determining impedance at each said frequency at a time;

(vi) fitting said impedance at each frequency to a theoretical frequency dependent impedance locus;

(vii) extrapolating the locus to obtain a value of impedance at zero frequency at said time;

(viii) repeating steps (v) to (vii) to obtain a time varying plot of the zero frequency impedance; and

(ix) calculating measures of cardiac function in the patient from said time varying plot of the zero frequency impedance.

Claim 2 (original): The method of claim 1 wherein said multiple simultaneous frequencies comprise at least three frequencies of stimulation.

Claim 3 (original): The method of claim 1 wherein said multiple simultaneous frequencies comprise at least five frequencies of stimulation.

Claim 4 (original): The method of claim 1 wherein said frequencies fall within the range 2-2000 kHz.

Claim 5 (original): The method of claim 1 wherein said frequencies fall within the range 10-500 kHz.

Claim 6 (original): The method of claim 1 wherein the frequency and waveform of the alternating current signal is selectable or fixed.

Claim 7 (original): The method of claim 1 wherein the current signal and the voltage signal are demodulated using Fast Fourier Transform.

Claim 8 (original): The method of claim 1 wherein the Fast Fourier Transform of said current signal and said voltage signal provides a phase value and an amplitude value from which impedance is determined.

Claim 9 (original): The method of claim 1 further including the step of recording an ECG and correlating the ECG with the time varying plot of impedance.

Claim 10 (original): The method of claim 1 wherein the change in the impedance value over time and the rate of change in the measured impedance signal dZ/dt is used to determine impedance parameters to calculate cardiac output of said patient.

Claim 11 (original): The method of claim 1 wherein a time derivative of said impedance signal is mathematically obtained using the extrapolated impedance at zero frequency (Z_0) or at infinite frequency (Z_{inf}).

Claim 12 (original): The method of claim 1 wherein the theoretical frequency dependant impedance locus is a Cole-Cole analysis.

Claim 13 (original): The method of claim 1 wherein steps (i) to (viii) are repeated to record at least one cardiac cycle.

Claim 14 (original): The method of claim 1 wherein measures of cardiac function are calculated using the following equation:

$$SV = (\rho L^2 (dZ/dt)_{max} VET)/ ((Z_B)^2)$$

where:

SV=stroke volume

$(dz/dt)_{max}$ = maximum rate of change in measured impedance at the beginning of systolic cycle

VET = left ventricular ejection time.

Claim 15 (currently amended): The method of claim 1 wherein measures of cardiac function are calculated using the following equation:

$$SV = (L'^3 (dZ/dt)_{max} VET)/(Z_B)$$

where:

SV = stroke volume

$(dz/dt)_{max}$ = maximum rate of change in measured impedance at the beginning of systolic cycle

VET = left ventricular ejection time

L' = thoracic length estimated from the subject's height and weight using a nomogram

[[L']] $\underline{Z_B}$ = blood resistivity.

Claim 16 (original): The method of claim 1 further including the step of measuring and recording the distance between the inner electrodes.

Claim 17 (original): The method of claim 1 further including the step of measuring and recording the height, weight, sex and age of the patient.

Claim 18 (original): The method of claim 1 wherein the steps of demodulating and determining an impedance at a time, comprises the steps of: sampling the impedance signals to obtain a sampled impedance; applying a time to frequency domain transform to said sampled signal to obtain transformed impedance signals; and filtering the transformed impedance signals and isolating each frequency to determine the impedance for each frequency at each time.

Claim 19 (currently amended): An apparatus for non-invasive measurement of cardiac function in a patient, said apparatus comprising:

a constant current source, electrically isolated from said patient, generating an alternating current signal at multiple simultaneous frequencies, which is applied to an outer pair of electrodes on a patient;

an inner pair of electrodes applied to a patient for measuring a voltage signal;

signal processing means for converting said applied current signal and measured voltage signal to impedance signals at each frequency at a time;

means for determining impedance values at a zero frequency (Z_0) and at infinite frequency (Z_{inf}) at a plurality of time intervals; and means for calculating measures of cardiac function in said patient from [[said]] <u>a time varying plot of the zero frequency</u> impedance values.

Claim 20 (original): The apparatus of claim 19 wherein said outer pair of electrodes comprise shields to protect the patient from stray current.